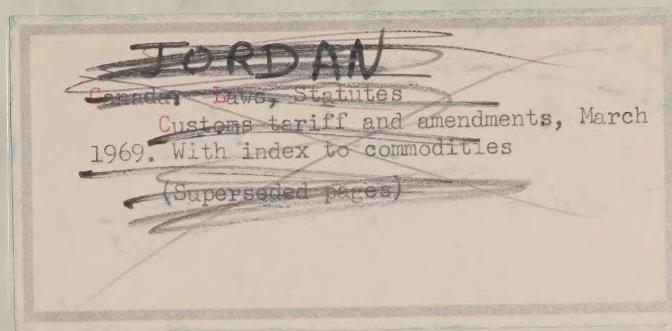


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A STATUS REPORT ON
ENVIRONMENTAL STUDIES IN THE
NANTICOKE AREA

Report prepared by Ontario Hydro on behalf of
The Nanticoke Environmental Committee

Members: Ontario Water Resources Commission
Ontario Department of Lands & Forests
Ontario Hydro
The Steel Company of Canada
Texaco Canada Limited

The Department of Energy and Resources Management,
Air Management Branch



W.R. Effer
Generation Projects Division
April 1971

INDEX

	<u>Page</u>
INTRODUCTION	1
LAKE STUDIES	1
(a) History of Programme	2
(b) Functions and Responsibilities	3
(c) Description of Activities	4
OWRC Water Quality Surveys Branch	4
Ontario Hydro Hydraulic Studies Department	5
Ontario Water Resources Biology Branch	6
Department of Lands & Forests, Research Branch	6
Department of Lands & Forests - Research Branch & District Branch	7
Ontario Hydro Research Division	7
(d) Approximate Costs, Lake Studies	8
AIR QUALITY SURVEYS	9
Ontario Hydro	9
Air Management Branch	9
Approximate Costs	10
VEGETATION SURVEYS	10
Air Management Branch, Phytotoxicology Section	11
Ontario Hydro	11
Approximate Costs	12

INDEX

1	INTRODUCTION
2	LIVE SOURCES
3	(a) HISTORY OF PROBLEMS
4	(b) ECONOMICS AND GEOGRAPHY
5	(c) DESCRIPTION OF VACCINATIONS
6	ONE MONTH OUTLOOK SURVEY
7	ONE MONTH HYGIENIC SURVEY
8	ONE MONTH REASONABLE BIOPSY
9	DEPARTMENT OF PLANNING & LOGISTICS
10	RESEARCH GROUP & DIRECTOR RESEARCH
11	DEPARTMENT OF PLANNING & LOGISTICS -
12	DEPARTMENT OF PLANNING & LOGISTICS -
13	DEPARTMENT OF PLANNING & LOGISTICS -
14	(1) APPROXIMATE CAPACITY SURVEY
15	VIR QUALITY SURVEY
16	QUALITY HYDRO
17	VIR MANAGEMENT SURVEY
18	APPRAISAL SURVEY
19	VIR MASTADONIC PLACEMENT, PROPOXIMOLYL SECTION
20	APPRAISAL SURVEY
21	VIR APPRAISAL SURVEY
22	APPRAISAL SURVEY
23	APPRAISAL SURVEY

INTRODUCTION

Starting in the 1960's an increasing awareness developed among scientists and the public that the effects of man's activities on his environment were not always insignificant. Results of scientific studies had already shown that the Great Lakes were undergoing accelerated eutrophication and that this was most evident in Lake Erie, the warmest and shallowest of the Great Lakes. When it became known that the Ontario Hydro was planning to build a generating station at Nanticoke, it was considered important that extensive studies should be made of conditions in the area, both before and after the building of the station, in order to determine its effect on the environment. The purpose of this report is to describe investigations being carried out in the pre-operational phase of the programme. These are lake studies, air quality surveys, and vegetation surveys.

LAKE STUDIES

The purpose of lake studies is to determine the impact, if any, of the thermal and other water quality changes on the aquatic organisms in the area of the lake near Nanticoke. Temperature and current measurements are necessary preliminaries to this study to define the area which is expected to be influenced by the plant discharges. Once this area is known, water quality and biological sampling stations in and outside the area can be set up. Measurements made before the emission of plant effluents will provide a picture of the normal or "base-line" conditions and also give indications of the natural variability of the organisms under study.

Phytoplankton are microscopic plants which float freely in the upper layers of the lake and convert the sun's energy into a source of food (in the process of photosynthesis) using dissolved carbon dioxide and hydrogen from the water. The phytoplankton are eaten largely by zooplankton, which are free moving microscopic animals. Zooplankton become the food source

INTRODUCTION

designed to fit the needs of a wide variety of people and situations and therefore it is not surprising that there are many different types of designs. The basic principle behind all of these designs is to provide a clear and concise way of presenting information in a form that can be easily understood by the user. This is achieved through the use of simple language, clear diagrams, and easy-to-follow instructions. The design also aims to be visually appealing and engaging, making it more likely that the user will remember the information presented.

CHAPTER 3

The purpose of this chapter is to introduce the reader to the basic concepts of design and how they relate to the field of ergonomics. It will also discuss some of the key principles of good design, such as user-centered design, accessibility, and sustainability. Finally, it will provide some examples of how these principles can be applied in real-world scenarios, such as product design, website development, and architectural planning. By the end of this chapter, the reader should have a better understanding of what good design is and how it can be used to improve their own work or products.

Product design is a discipline that involves creating products that are safe, functional, and aesthetically pleasing. It requires a deep understanding of both the user and the product, as well as the ability to translate complex ideas into simple, intuitive designs. One of the most important aspects of product design is user-centered design, which focuses on the needs and preferences of the target user. This approach ensures that the final product is not only functional but also enjoyable to use. Another key aspect of product design is accessibility, which means that the product should be usable by people with disabilities. This includes ensuring that the product is easy to use for people with physical, cognitive, and sensory impairments. Finally, product design should also consider environmental factors, such as energy efficiency and recyclability. By taking these factors into account, product designers can create products that are not only useful but also sustainable.

of bottom living organisms such as the larvae of mayfly and caddisfly, crustaceans and snails, which in turn are consumed by fish. Many types of organisms are present at each level of the food chain and these consume or are consumed in a variety of ways, the result being that a food web rather than a food chain actually exists. If one species is reduced or increased in numbers, changes in the levels of other components of the food web occur in an attempt to accommodate this change. When an extreme imbalance occurs, the web may become upset and a deterioration of the biological quality of the water occurs.

In this pre-operational study, measurements of the composition and population densities of phytoplankton, zooplankton, bottom fauna and fish will provide details of the food web's main components. In the post-operational period, continuing measurements of these organisms will indicate what changes have occurred, if any, due to changes in the environment. It should also be possible to draw some conclusions about the area over which changes may have occurred.

Naturally occurring temperature fluctuations along the shoreline of the Great Lakes indicate that fish are normally capable of tolerating some temperature stresses in order to survive and reproduce. The main objective of this study is to find out if man-made temperature modifications, superimposed on the naturally occurring temperature fluctuations have adverse effects on these elements of the aquatic community which may be close to their upper level of the thermal tolerance.

(a) History of Programme

The Ontario Hydro, Ontario Water Resources Commission (OWRC) and the Department of Lands and Forests, Fish and Wildlife Branch held several meetings, starting in 1967, to discuss the heat input to the lake, cooling-water intake design, lake currents, sewage and ash disposal methods and the many other operations which may influence the water quality and

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biology of the area. Many of the plant operations and design features had to receive the approval of the regulatory bodies at this early stage. During this early period, both the OWRC and Ontario Hydro made water quality, temperature and current surveys in the area in order to supply information for the station design.

The obvious need for a procedure to study as many environmental factors as possible and to integrate the activities of the various groups led to the setting up of a Nanticoke Environmental Committee in early 1968. This Committee initially consisted of representatives from Ontario Hydro, OWRC and Lands and Forests, who drew up a programme of studies and developed a system of coordinating the activities of the numerous groups involved. Since its inception, the Committee has had a member of the OWRC as Chairman. In 1968, the Steel Company of Canada (Stelco) made known its plans for a development on the shoreline adjacent to the Ontario Hydro, and joined the Committee in July of that year. Some of the programmes were revised and extended at this time in order to include the shoreline occupied by the Stelco plant.

In 1969, most of the individual studies of the programme became active. In early 1970 Texaco joined the Committee as a result of its planned development in the area. During this period Stelco announced a delay in its development plans but continued to support the research effort. In early 1971, a tripartite agreement (Hydro, Stelco and Texaco) was signed for the financial support of a programme of fish studies to be carried out by Lands and Forests. The Committee plans to issue a report at the end of 1971 covering the results of the whole pre-operational period, 1967 - 1971.

(b) Functions and Responsibilities

The groups involved and their areas of study are summarized in Table 1. The planning, direction and analysis of



results are the responsibilities of the group in charge. The activities of the assisting group generally include the provision of some staff and equipment for taking of water samples and dispatch to the appropriate laboratories for analysis. Contributions to the cost of capital equipment and on-site operating expenses have been made by other participating groups.

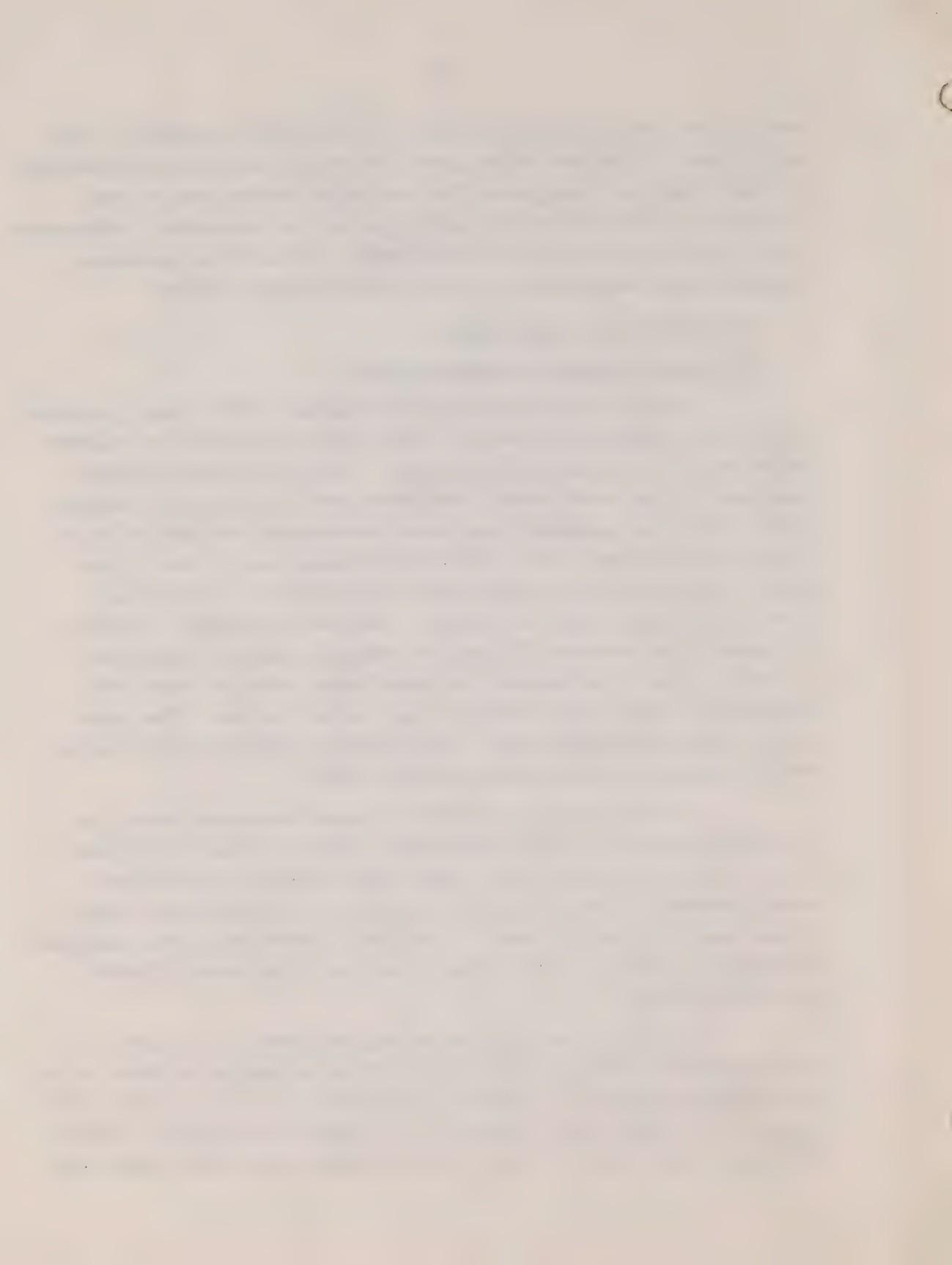
(c) Description of Activities

OWRC Water Quality Surveys Branch

During the period August-December 1968, three recording current and temperature meters were used to measure the current patterns in the area off Nanticoke. Three instrument towers, designed by the OWRC, were fabricated and installed by Ontario Hydro, who also gathered wind data, monitored the operation of the instruments and did calibrating drogue runs. Two of the meters were provided by OWRC and one by Stelco. Using the records obtained from the meters, the OWRC developed a method for predicting average dispersion characteristics along the offshore area. Predominant currents were from the west with directions being more constant near the shoreline. The east-west current movements were significantly dependent on wind and water levels for all months except October.

In the winter of 1969-70, water movements under the ice were measured, using a recording current meter. Currents were found to be much slower than under ice-free conditions. Water movements were generally in the same direction as those where there was no ice cover. Further current data was obtained throughout 1969 using the meters near both the Ontario Hydro and Stelco sites.

In 1968 an extensive survey was made in the area to measure water quality variability and to determine by statistical analysis the number of sampling stations in the area which would adequately record this variability. Based on the study, eight stations were chosen. These stations have since been used for



the sampling of bottom fauna, phytoplankton and zooplankton. (Figure 1). Water analysis during 1969 at these eight stations indicated that quality tended to be spatially homogeneous with only small variations in alkalinity and turbidity. Depth had little effect and there was no appreciable stratification between April and December. A seasonal variation in alkalinity and pH was found to occur. Based on these results, the 1970 sampling programme was continued with a smaller number of samples.

Ontario Hydro Hydraulic Studies Department

During 1967, water temperatures were measured continuously at the Jarvis water works pumphouse and non-continuously at several points in a twelve square mile area near the Nanticoke site. In 1970 further temperature measurements were made along the shoreline east of the site and at the eight sampling stations. A maximum surface temperature of 76° was recorded. An average temperature drop of approximately 10°F between the surface and the 25 ft. depth occurred in June which was reduced to 2° in August.

Water currents were measured in 1967 and 1968, using drogues and transits. Wind was found to be the major factor influencing the shoreline currents, although rapid changes in lake stage at times dictated current direction into or out of Long Point Bay. Winds have been measured continuously since 1967. Over a 3 year period, the wind has been shown to come from the west quadrant 39% of the time, east 15%, north 23% and south 23%. Based on water temperature and current surveys at the Lakeview generating station on Lake Ontario during 1969 and 1970, the areas of the lake off Nanticoke to be influenced by the thermal discharge has been computed. Results indicate that in a summer day with no wind, when cooling of the discharge is slowest, the water temperature will have decreased to one degree above lake ambient temperature within two miles from the discharge point. (Figure 2).

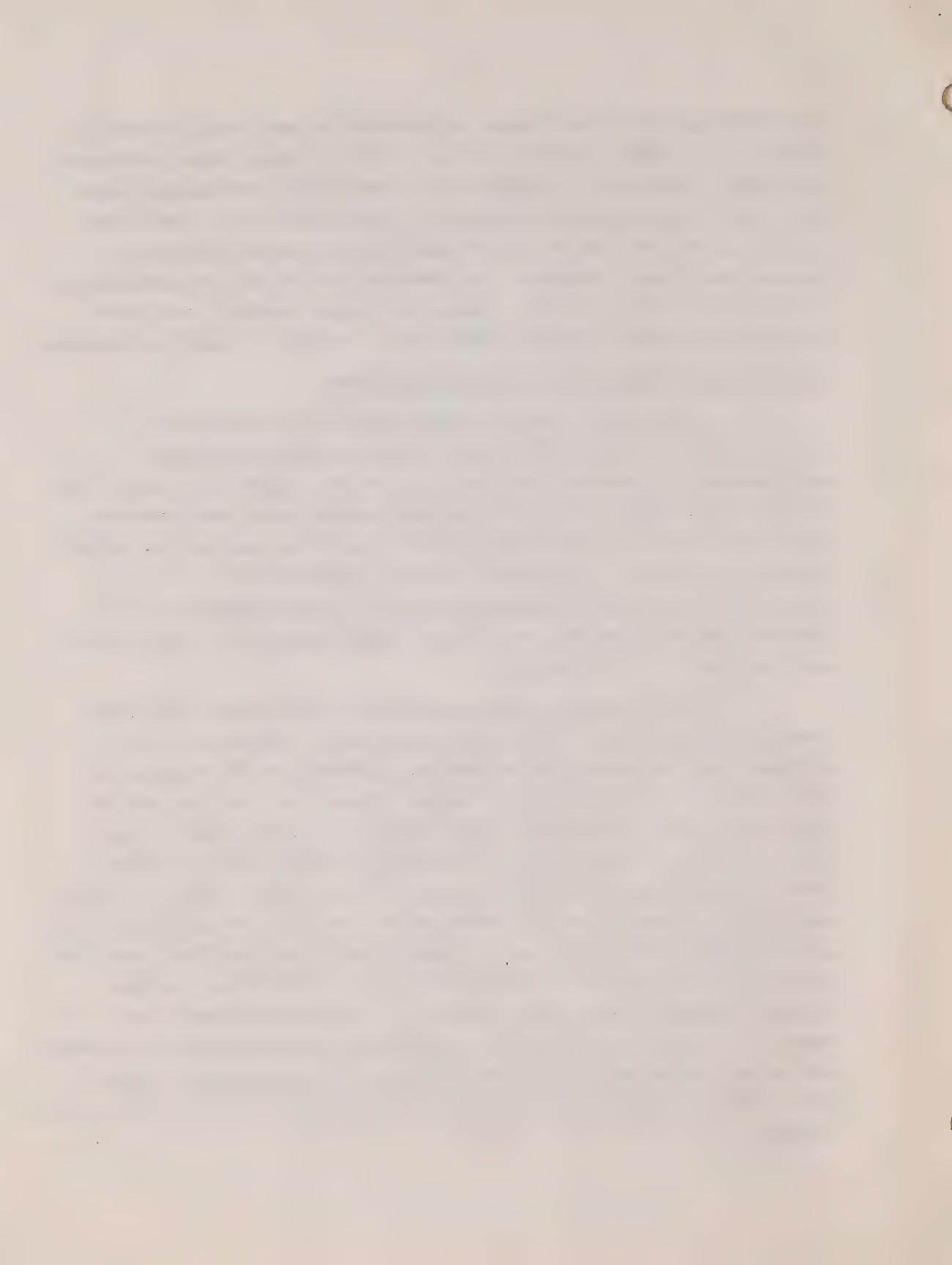
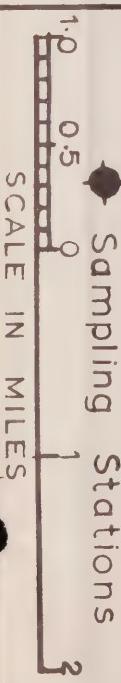


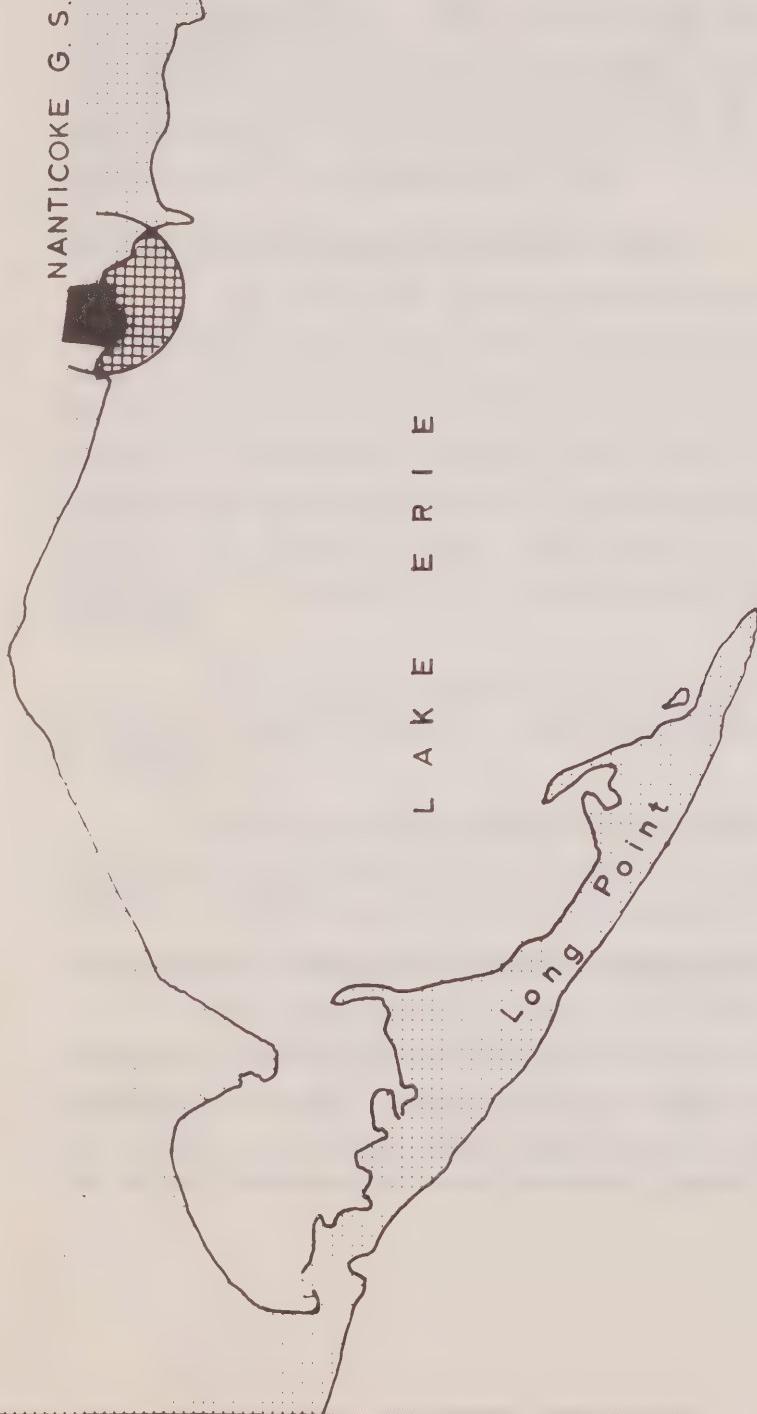
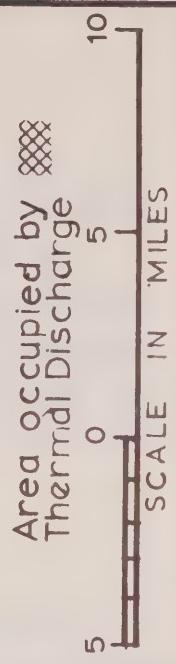
FIGURE 1
LAKE STUDIES



L A K E E R I E



FIGURE 2





Ice observations since 1967 have shown that only in 1968, a colder than average winter, was there a solid ice cover and this broke up during the winter under the influence of milder temperatures. The location and extent of weed beds have been observed from the air and ground since 1967. In addition, the amount and location of weed washed up on the shorelines has been recorded. More ice observations, wind and water temperature measurements are planned for 1971.

Ontario Water Resources Biology Branch

In late 1968 a preliminary bottom fauna and phytoplankton survey was made in order to determine the best sampling procedures for future work. In 1969 sampling of bottom fauna and phytoplankton from the eight designated stations was started. Preliminary bottom fauna results indicate that species composition between stations is similar with the exception of the station off Peacock Point. The station off Nanticoke Creek appears to be supporting a consistently higher number of organisms.

In 1971 the sampling is to be extended slightly to include a station closer to the Nanticoke generating station discharge.

Phytoplankton samples were taken at bi-weekly intervals from April to November in 1969 and 1970. The extensive data on species composition and distribution have not yet been analyzed.

Department of Lands and Forests, Research Branch

The zooplankton sampling was carried out at bi-weekly intervals from April to December in 1969 and 1970 at the eight sampling stations. Analysis of the 1969 collections indicates that season and depth both significantly affect genus composition. Two major groups are being examined quantitatively.

Department of Lands & Forests - Research Branch & District Branch

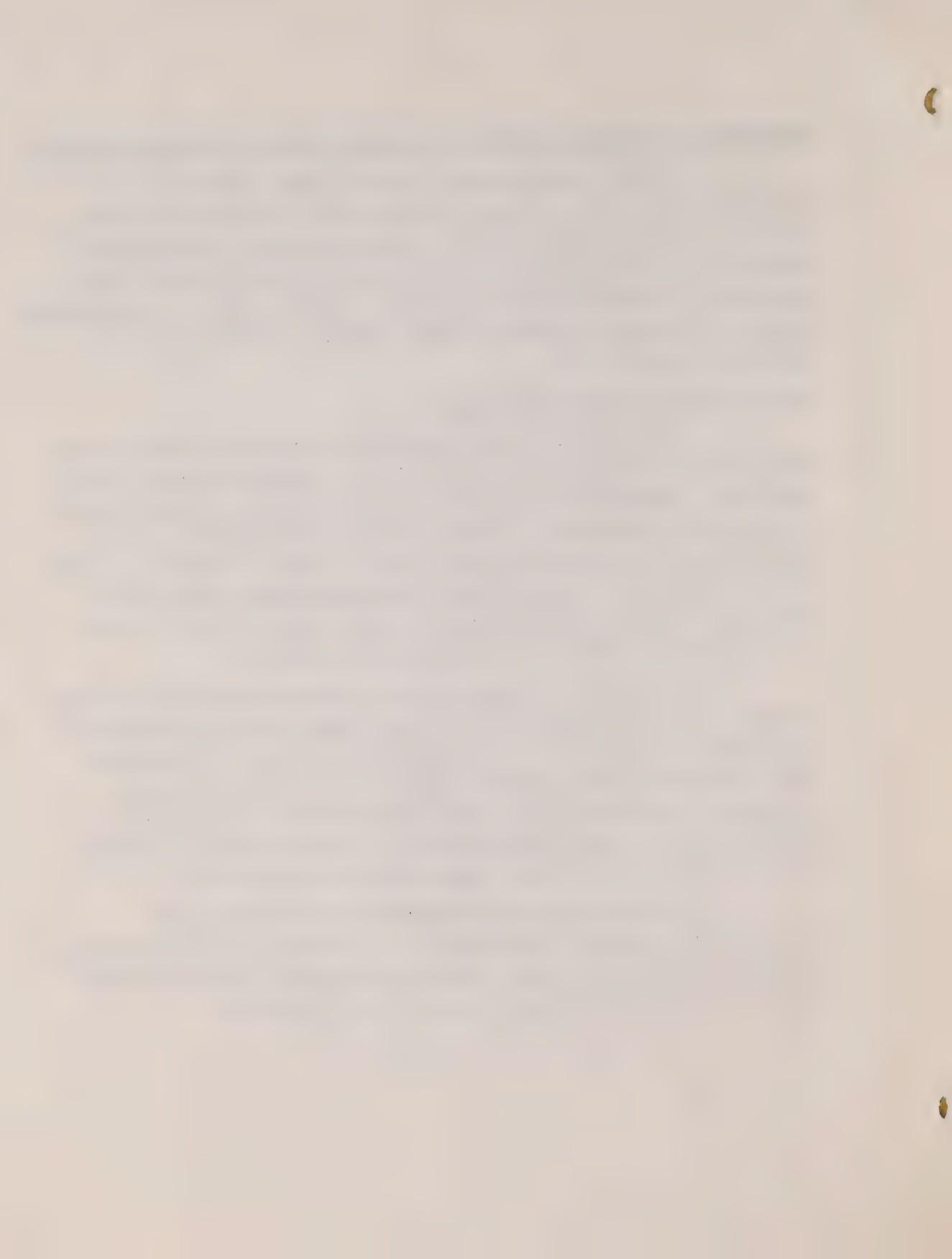
In 1968 approximatley 200 fish were caught off Nanticoke and tagged. Nearly 10% of these fish were recovered, all from Inner Long Point Bay. Much supporting information on spawning and fish movement in the area has been obtained from commercial catches and creel census. Further fish and temperature studies, financed by Ontario Hydro, Stelco and Texaco will be started in spring 1971.

Ontario Hydro Research Division

Temperatures, dissolved oxygen and water conductivity were measured continuously at the Jarvis pumphouse during 1968 and 1969. Attempts to measure rates of growth of aquatic weeds on artificial substrates during 1969 were unsuccessful due to poor growth at the depths chosen, and to loss and damage of some of the substrates. Observations and measurments were made on naturally occurring shoreline substrates during 1970. In 1971 it is planned to make more detailed measurements.

Studies were carried out at Lakeview generating station on Lake Ontario during 1969 to provide some further information on possible influences of the Nanticoke station. Filamentous weeds tended to start growing slightly earlier in the warm discharge water than in the cold intake water. Weed growth declined and the weeds died earlier in the warm water however, the total yield at the two temperatures being similar.

Dissolved oxygen measurements of the warm water discharge at Lakeview showed that at no time of year was dissolved oxygen lost during passage through the station's cooling water system, or in the discharged water during cooling.



(d) Approximate Costs, Lake Studies

	<u>To 1969</u>	<u>1970</u>	<u>1971*</u>
<u>Ontario Hydro</u>			
Hydraulic Studies	112,000	27,000	39,000
Research	2,000	1,000	4,000
Lands & Forests Support	-	-	33,000**
<u>O.W.R.C.</u>			
Water Quality Surveys	61,000	6,000	3,000
Research	6,000	4,000	5,000
Water Treatment, Industrial Wastes	2,000	2,000	2,000
<u>Lands & Forests</u>			
Research	12,000	***	***
<u>Stelco</u>			
Sampling & Equipment	13,000	16,000	16,000
Lands & Forests Support	-	-	17,000**
<u>Texaco</u>			
Lands & Forests Support	-	-	<u>17,000**</u>
	<u>TOTALS</u>	<u>208,000</u>	<u>36,000</u>
			<u>136,000</u>

* Estimated

** The total financial commitment in support of Lands & Forests Fishery Studies to 1974 will be, Ontario Hydro \$100,000, Stelco and Texaco each \$50,000.

*** Expenditures included in tripartite agreement amounts. Funding under agreement is for 4 years Research (1970-73) and for 3 years support of Fish & Wildlife Branch research (1971-73).



AIR QUALITY SURVEYS

In the Nanticoke area, air quality is influenced by contaminants from minor local sources and by low levels of air pollutants originating from distant industrial areas. With the arrival of industry, it is essential to monitor air quality to ensure that the criteria are met and that any projected future developments can be controlled.

Ontario Hydro

In January, 1970 a monitoring network was set up consisting of 23 lead peroxide candles for measuring sulphur dioxide levels, and 4 trailers equipped to continuously measure wind speed, direction, sulphur dioxide and ozone. (Figure 3). Starting in March, results from the continuous recorders were placed on a computer. From this information, the changing background of each pollutant can be related to atmospheric conditions.

This survey will continue during the construction of the station and for a period of at least two years after the start of full plant operation. The area chosen for survey was selected to include the activities of Ontario Hydro, Stelco and Texaco and has been approved by Air Management Branch.

Air Management Branch

A continuous air monitoring station has been operating at the Horticultural Experiment Station at Simcoe since the summer of 1970. Two continuous nitrogen oxide analyzers have been installed in Ontario Hydro trailers near the Nanticoke station in February of 1971. It is expected that monitoring will be carried out over several years of industrial construction in the area.



FIGURE 3
AIR POLLUTION — SURVEY AREA

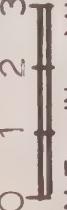
Air Sampling Station

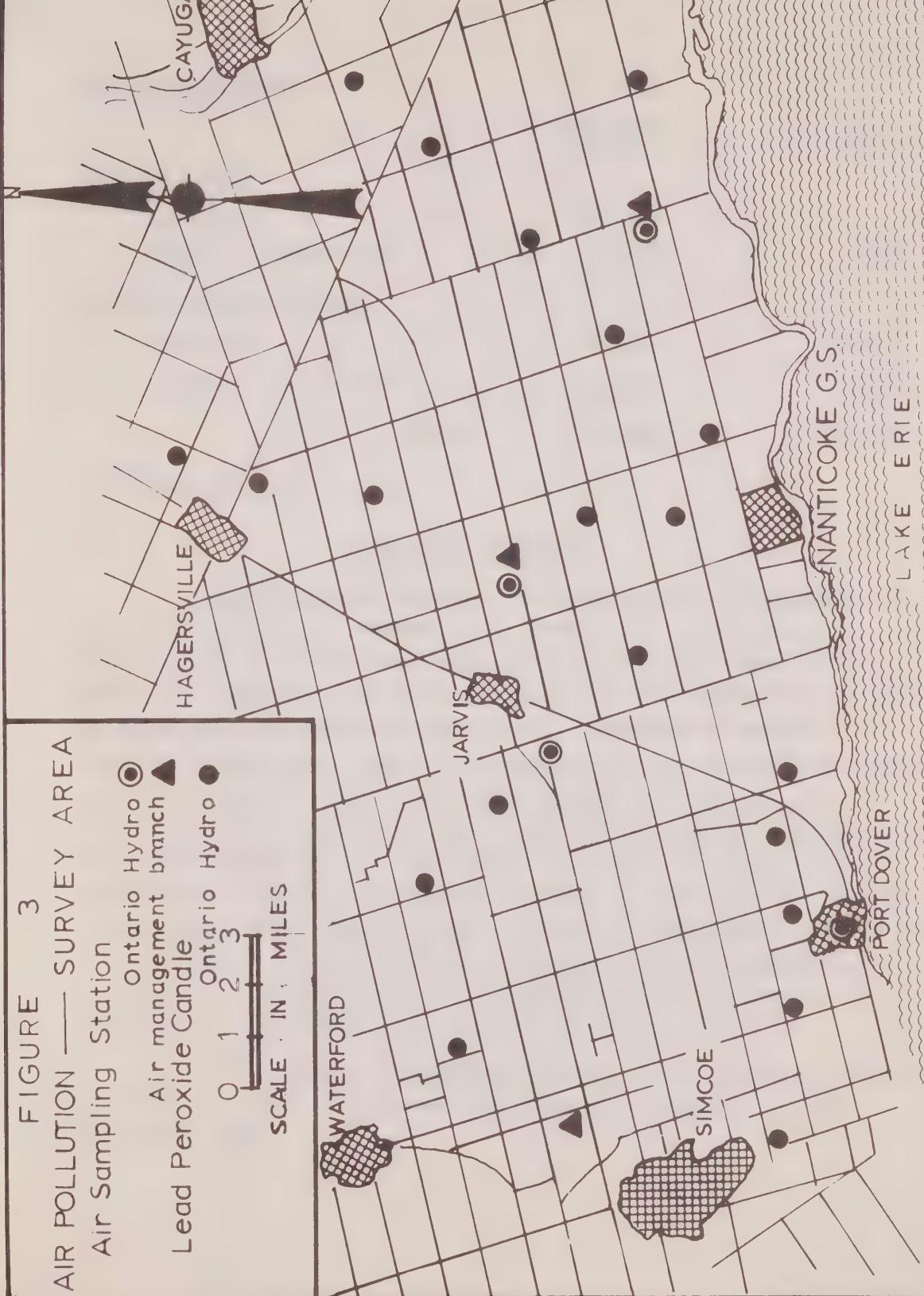
Ontario Hydro ○

Air management branch ▲

Air Peroxide Candle

Ontario Hydro ●

SCALE IN MILES






Approximate Costs

	<u>To 1970</u>	<u>1971*</u>
<u>Ontario Hydro</u>		
Equipment	68,000	-
Labour & Operations	67,000	34,000
<u>Air Management Branch</u>		
Equipment	40,000	10,000
Labour & Operations	<u>2,000</u>	<u>2,000</u>
TOTALS	<u>177,000</u>	<u>46,000</u>

* Estimated

VEGETATION SURVEYS

Monitoring of specific air pollutants is valuable for recording changes or trends in a given area. However, observations on vegetation provide an inexpensive and accurate means for measuring the actual effects of air contaminants, some of which may not have been monitored. Vegetation generally exhibits a much more sensitive response to air contaminants than animals or humans and it therefore serves to forecast any potential effects to which these populations may be exposed. Any long term trends due to introduction of very low levels of air contaminants may be recorded by changes in growth rates of long-living vegetation such as trees. Finally, vegetation surveys of an area before introduction of a suspected air contaminant are valuable for recording vegetation damage which may be due to existing air pollution or a variety of other causes.

Both the Air Management Branch, Phytotoxicology section, and Ontario Hydro are conducting vegetation surveys in the Nanticoke area.

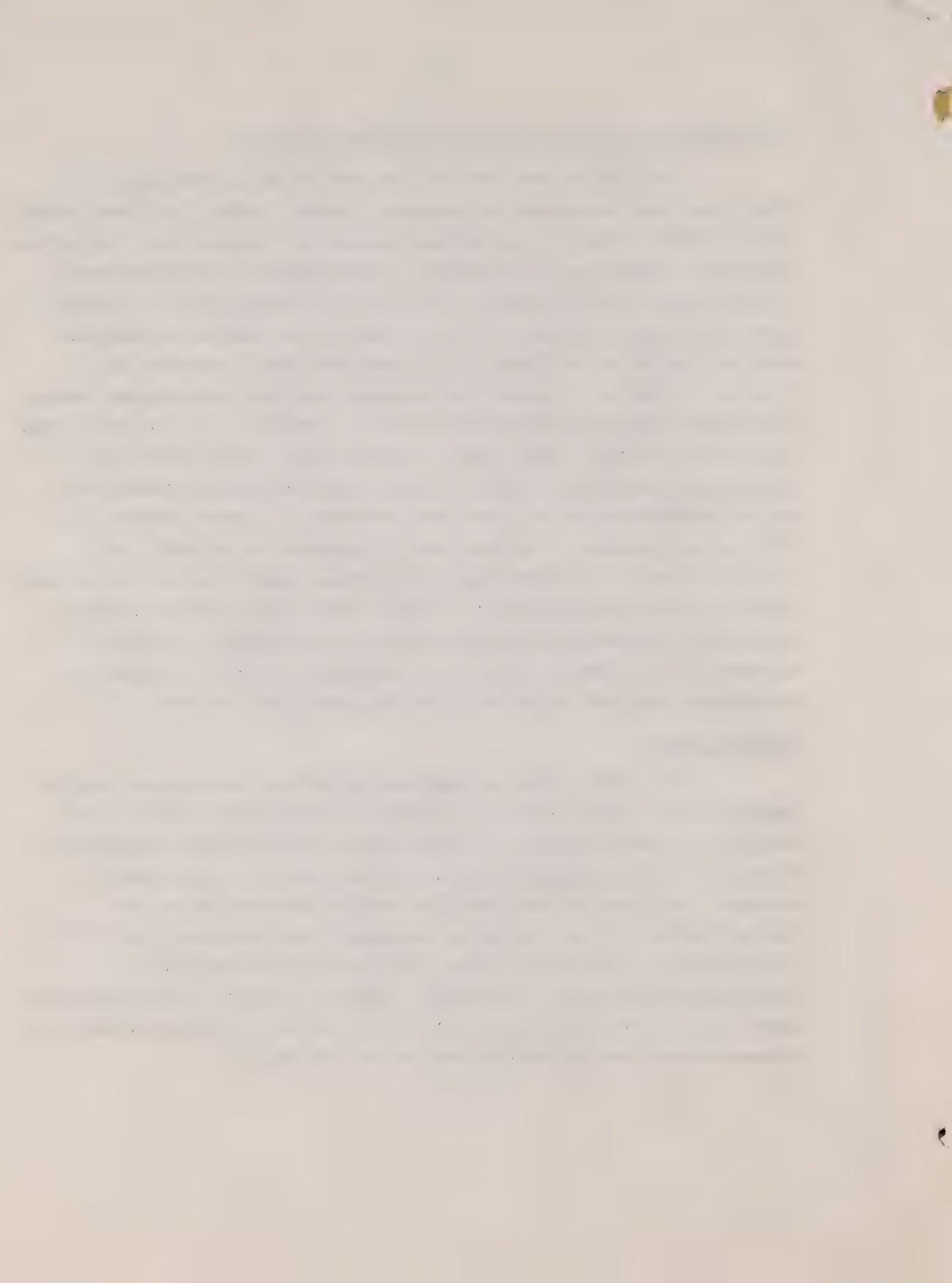
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Air Management Branch, Phytotoxicology Section

In 1969 a land-use survey was made of the area to determine the locations of tobacco, tomato, dairy and beef farms, and of other crops and naturally occurring vegetation, including woodlots. Based on this survey, 36 vegetation stations were established in 1970 along 5 radii at distances up to 50 miles from Nanticoke. At each station vegetation and soil samples were collected to be chemically analyzed for fluoride and sulphur contents. Vegetation sampled included deciduous trees, coniferous trees, shrubs and forage. Sampling will be conducted at these locations each year. In addition, other plots of existing vegetation, mostly trees, have been established for making measurements of long-term changes in growth rates. In 1971 it is planned to extend the programme to include the establishment of planted plots utilizing seedlings of three tree species, and to monitor air contaminants using annual plots of sensitive indicator vegetation such as gladiolus. Periodic surveys will be made of all the vegetation plots in order to correlate observed injuries with air sampling records.

Ontario Hydro

In 1969, after a vegetation survey, evergreen needle samples were taken from 20 locations in different directions and up to a distance of 12 miles from the Nanticoke Generating Station. These samples are to be analyzed for the possible changes in chemical composition due to absorption of air contaminants. This sampling procedure was repeated in 1970. In addition, the surveys have included the photographic recording of existing vegetation damage. In 1971 and subsequent years, plots of sensitive vegetation are to be placed under the transmission line extending north of the site.



Approximate Costs

	<u>1969</u>	<u>1970</u>	<u>1971*</u>
Air Management Branch	3,000	10,000	10,000
Ontario Hydro		1,000	3,000

* Estimated

